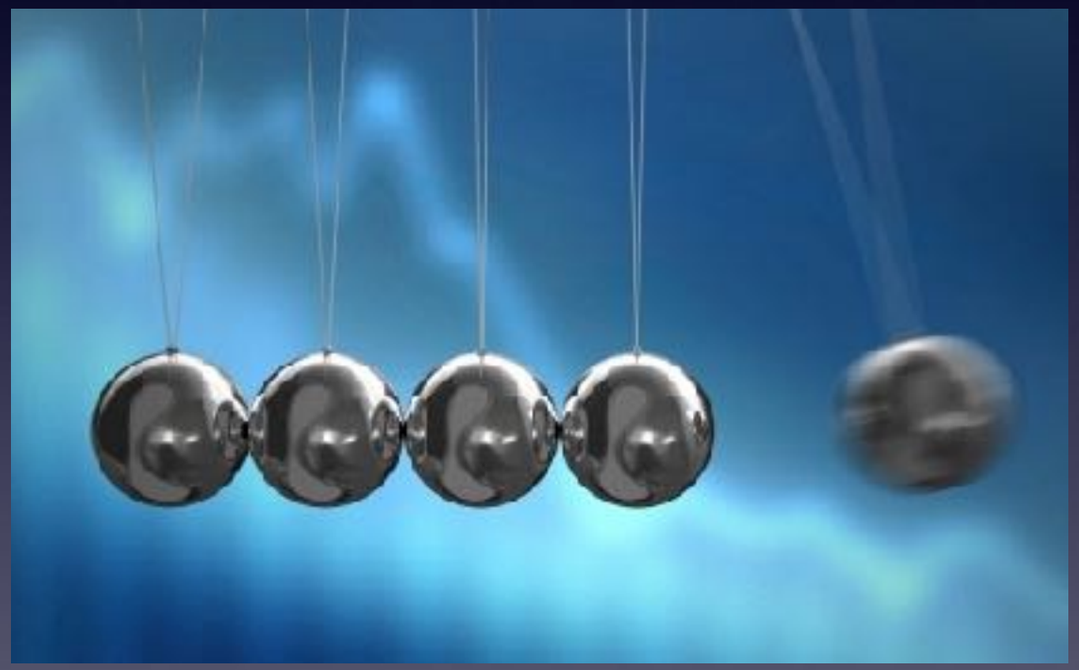
Newton's Third Law

Actions & Reactions

Newton's Third Law of Motion

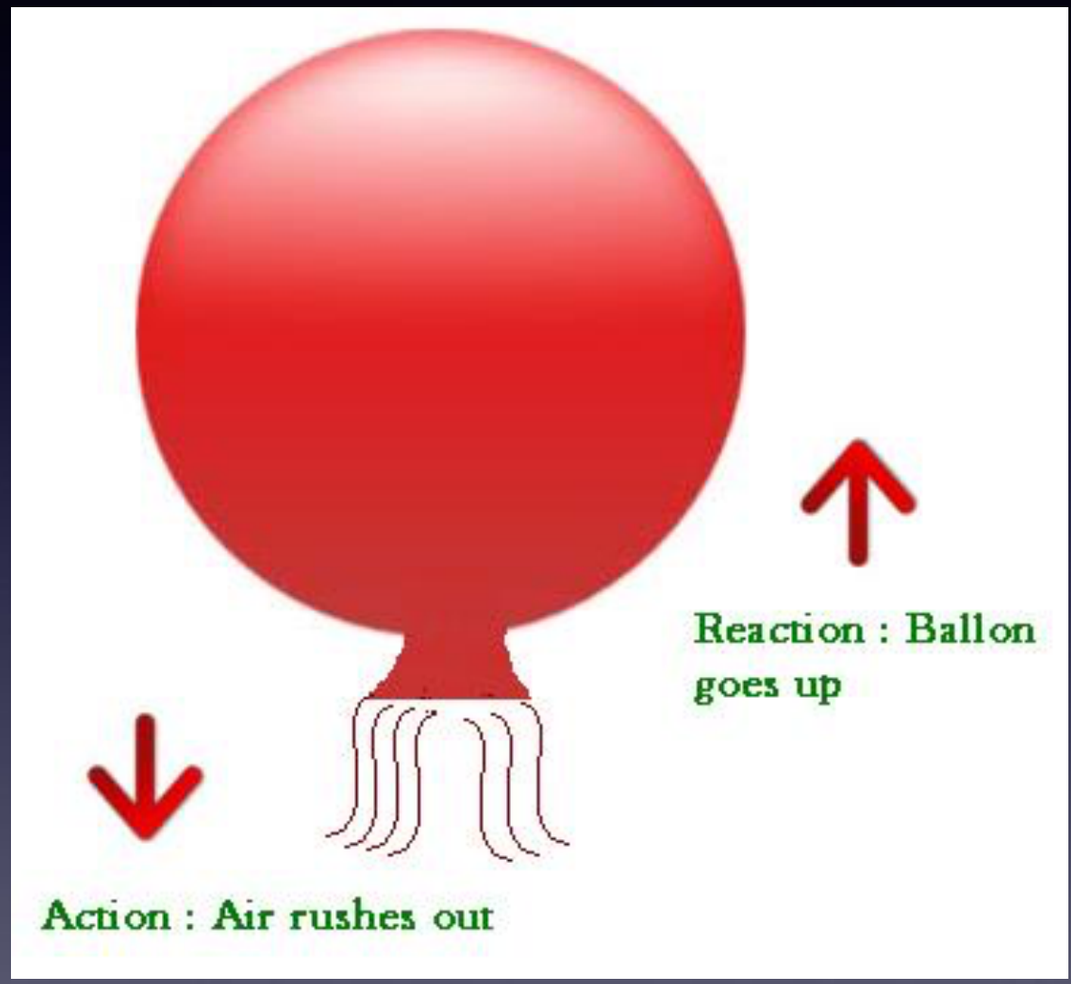
Forces are not "one-sided". Whenever one object exerts a force on a second object, the second objects exerts a force back on the first object.

The force exerted by the second object is equal in strength and opposite in direction of the first force. The first force is called the "action" and the other force is called the "reaction".



Newton's third law of motion describes the relationship between these two forces. Newton's third law of motion states that if one object exerts a force on another object, then the second object exerts a force of equal strength in the opposite direction on the first object.

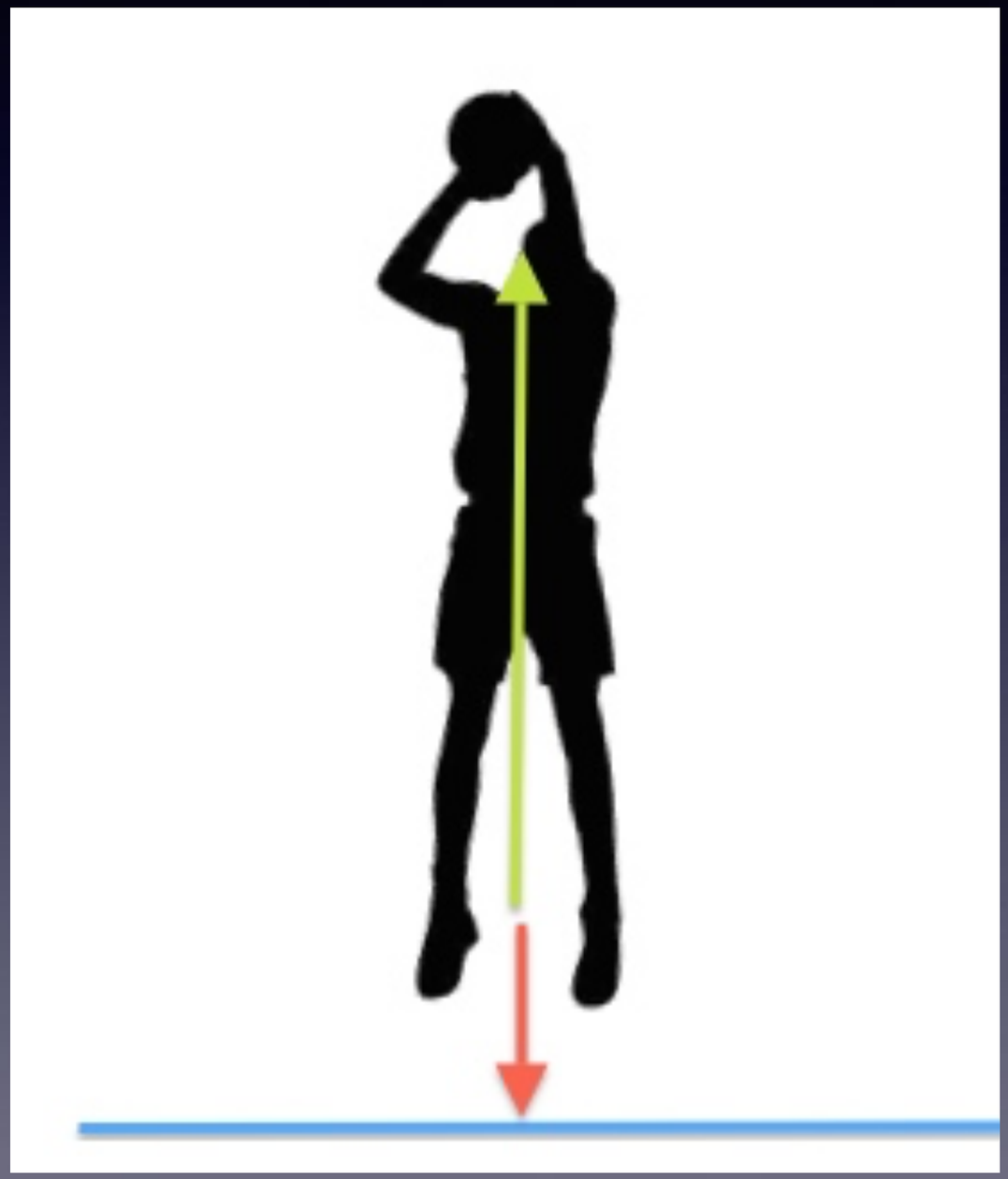
Another way to state Newton's third law is that for every action there is an equal but opposite reaction.



Action - Reaction Pairs

Pairs of action and reaction forces are all around you. When you jump, you push on the ground with your feet. This is an action force.

The ground pushes back on your feet with an equal and opposite force. This is the reaction force.



Detecting Motion

You cannot always detect motion when pared forces are in action. An example of this is when Earth's gravity pulls on an object, you cannot detect Earth's equal and opposite reaction.

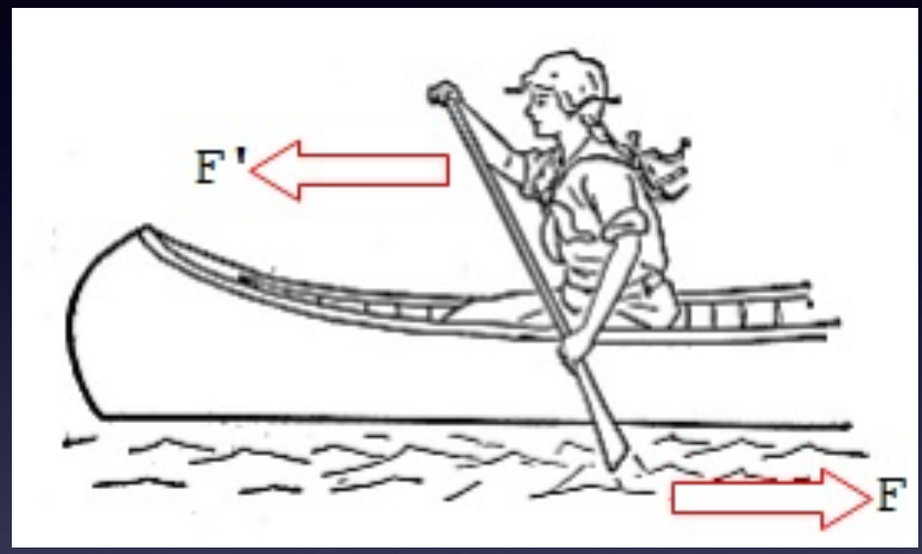
You don't see Earth accelerate toward the object because Earth's inertia is so great that its acceleration is too small to notice.

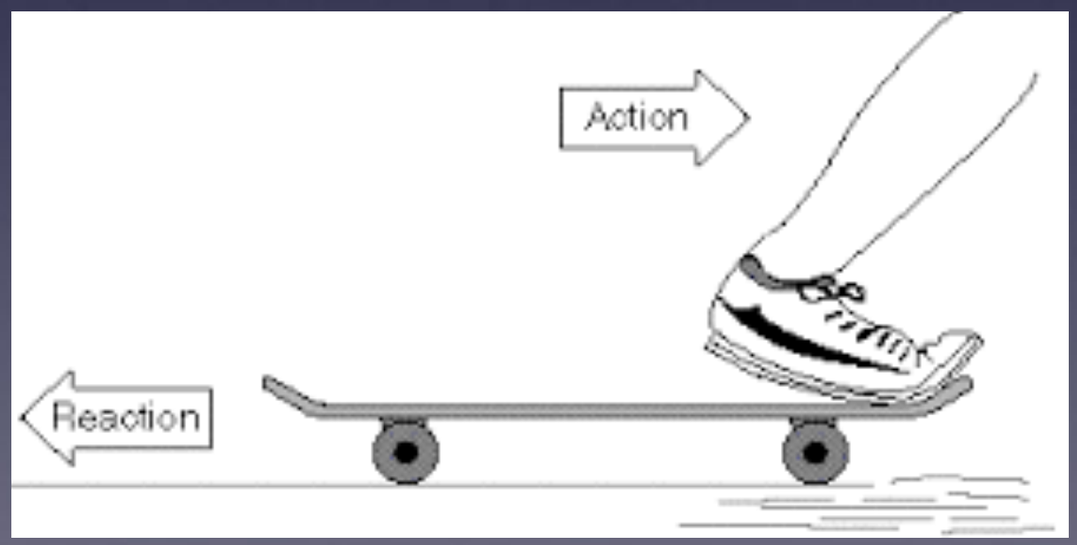
Do Action - Reaction Forces Cancel?

Newton's third law refers to forces on two different objects.

The action and reaction forces described by this law cannot be added together because they are each acting on a different object.

Forces can be added together only if they are acting on the same object.





For example, if a volleyball player hits a ball, she exerts an action force on the ball. In return, the ball exerts an equal but opposite reaction force back on her hands. The action and reaction forces act on different objects.

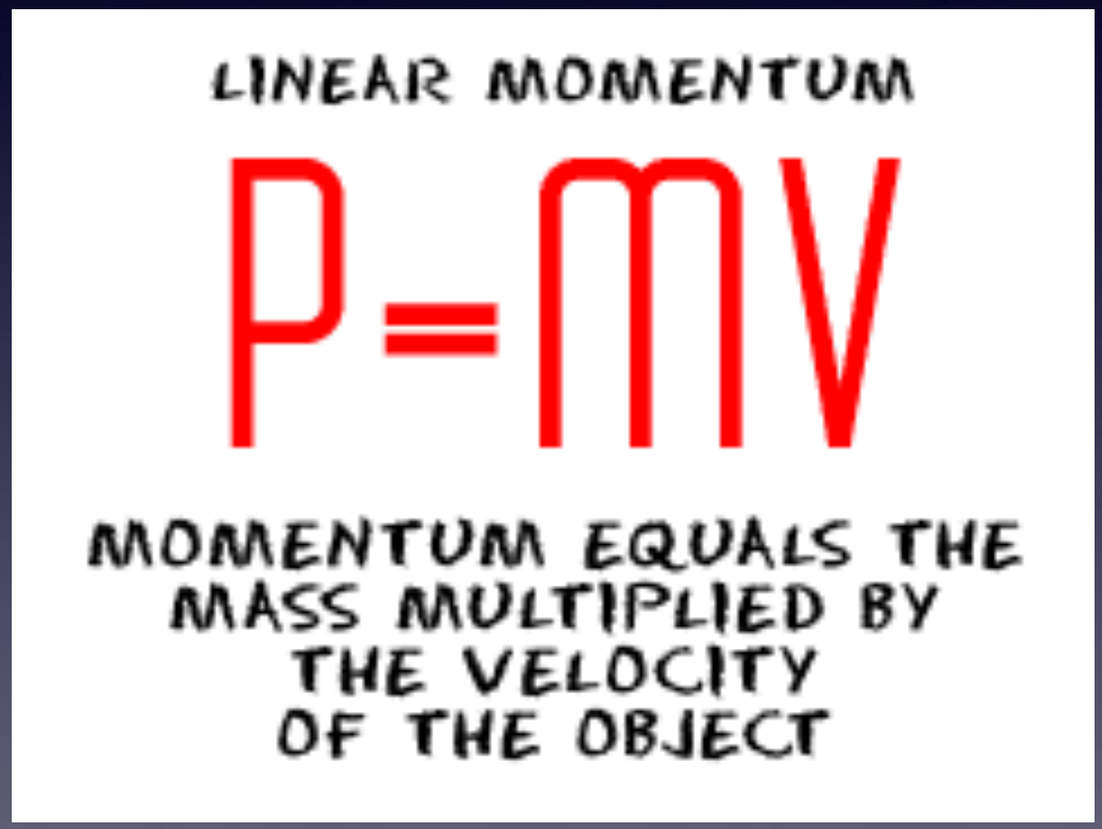
But if two volleyball players both exert a force on the same object – the volleyball – when they hit the ball from opposite directions, each of their hands exerts a force on the ball equal in strength but opposite in direction. The forces on the volleyball are balanced and the ball does not move in either direction.

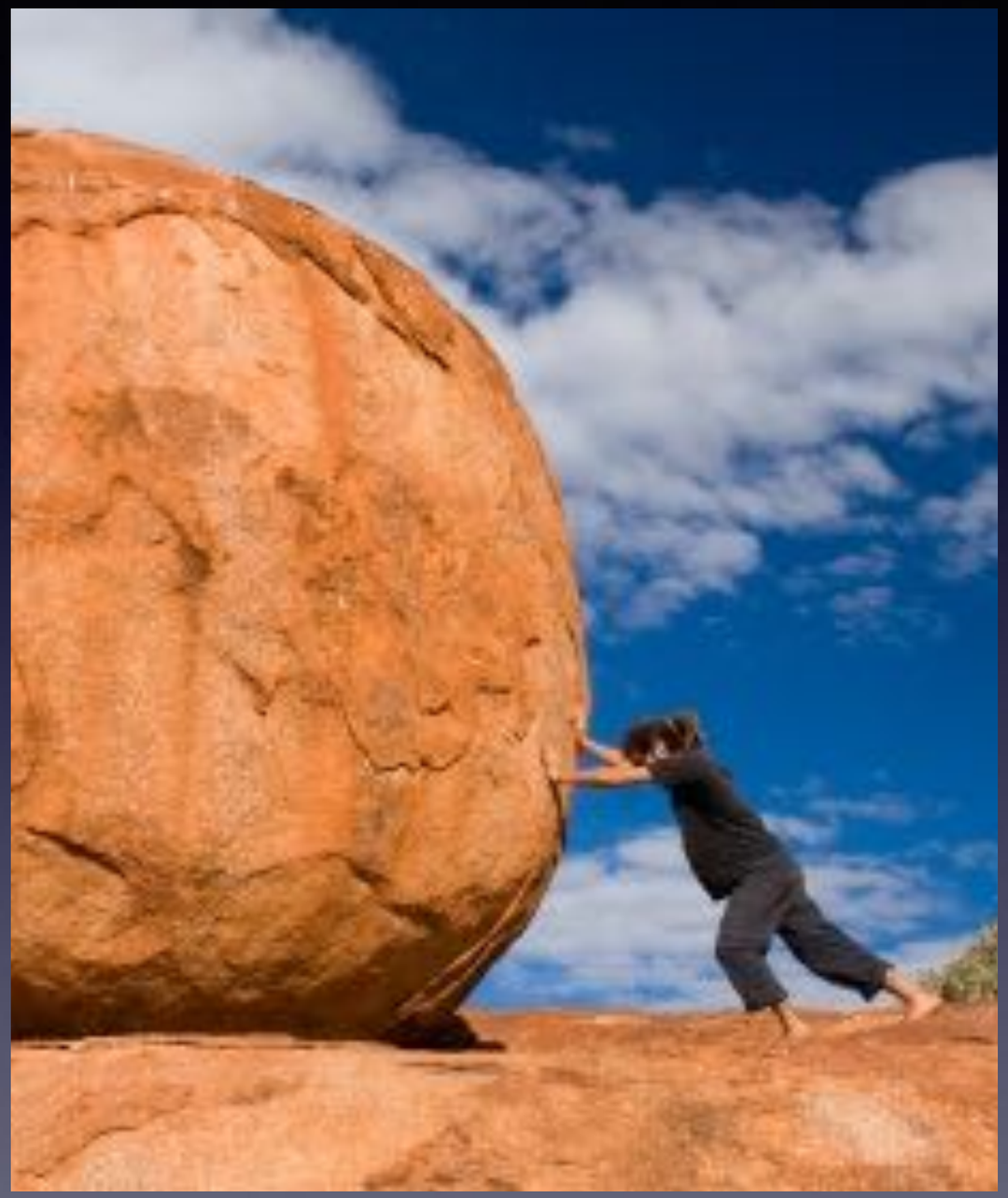
Momentum

All moving objects have what Newton called a “quantity of motion”. We call it momentum. Momentum is a characteristic of a moving object that is related to the mass and the velocity of the object.

The momentum of an object can be determined by multiplying the object's mass and its velocity.

Momentum = Mass X Velocity





The unit for momentum is kilogram-meters per second (kg.m/s), since mass is measured in kilograms and velocity in meters per second. Like velocity and acceleration, momentum is described by its direction in addition to its quantity.

The momentum of an object is in the same direction as the velocity of the object. The more momentum a moving object has, the harder it is to stop.

Conservation of Momentum

The word *conservation* has a special meaning in physical science. In everyday language, conservation means saving resources. You might conserve water or electricity.

In physical science, conservation refers to the conditions before and after some event. An amount that is conserved is the same amount after an event as it was before.

The amount of momentum objects have is conserved when they collide. When two objects collide in the absence of friction, momentum is not lost.

A quantity that is conserved is the same after an event as it was before an event.

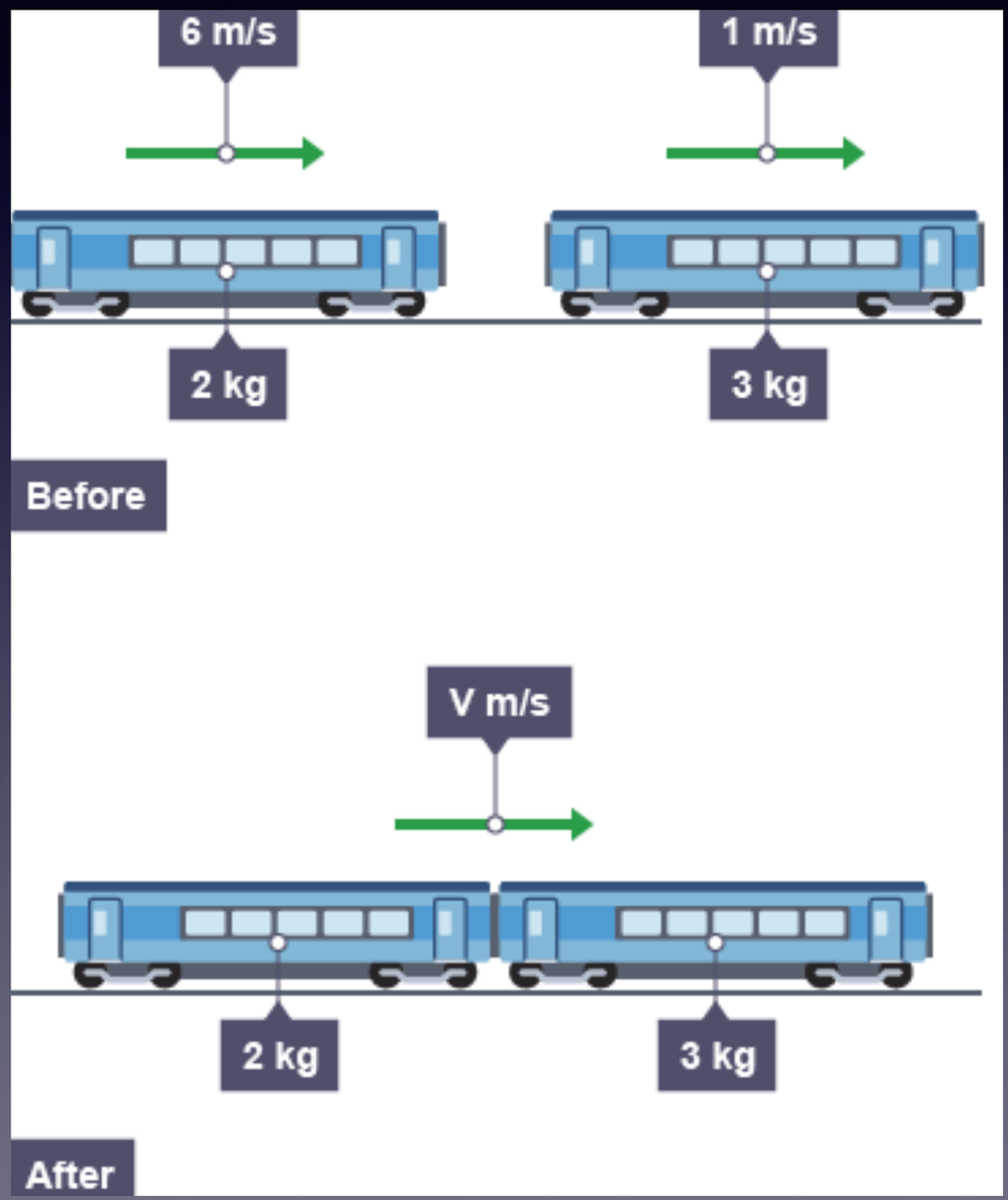
The law of conservation of momentum states that, in the absence of outside forces, the total momentum of the objects that interact does not change. It is the same before and after the interaction.

The total momentum of any group of objects remains the same, or is conserved, unless outside forces act on the objects. Friction would be an example of an outside force that might act on the objects.

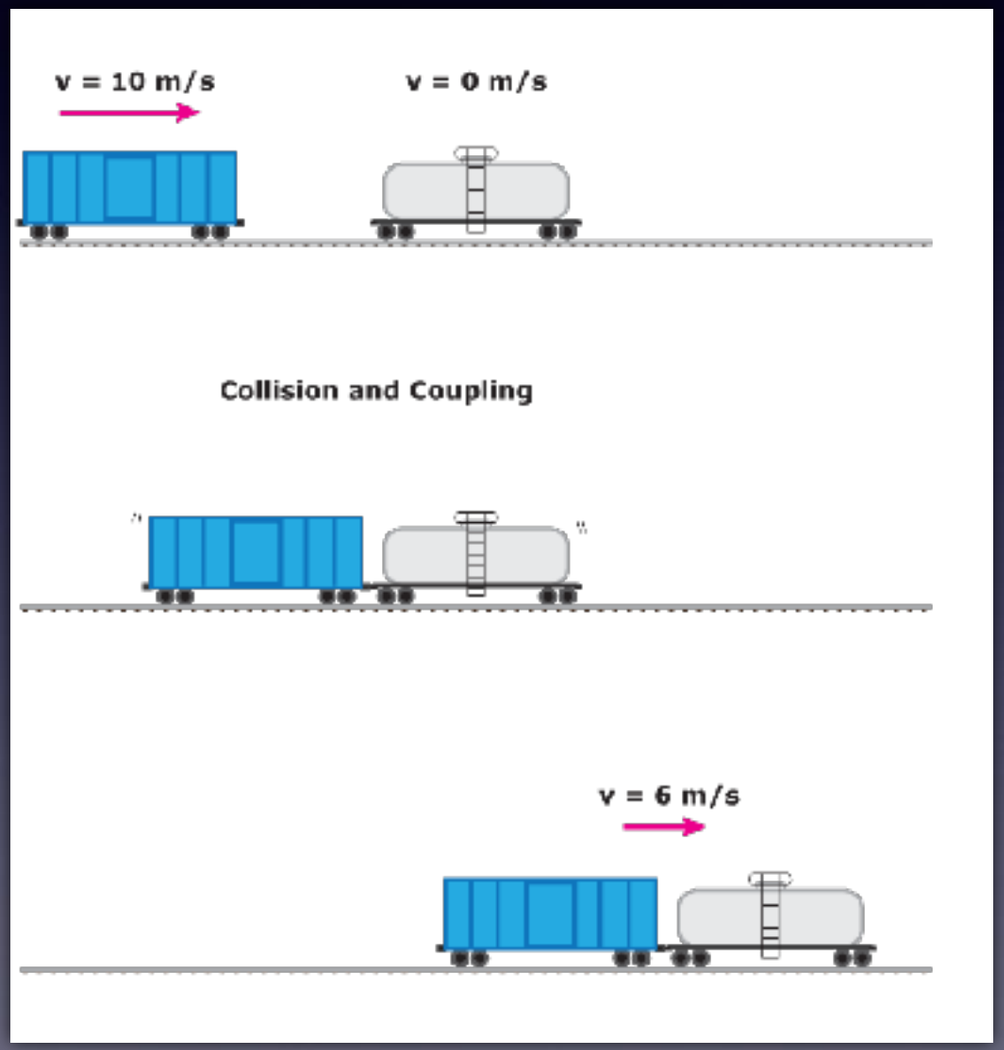
Collisions with Two Moving Objects

Momentum is conserved when two objects, such as trains, collide.

If one train traveling fast collides with a slower-moving train on the same track, the faster train slows down, and the slower train speeds up.



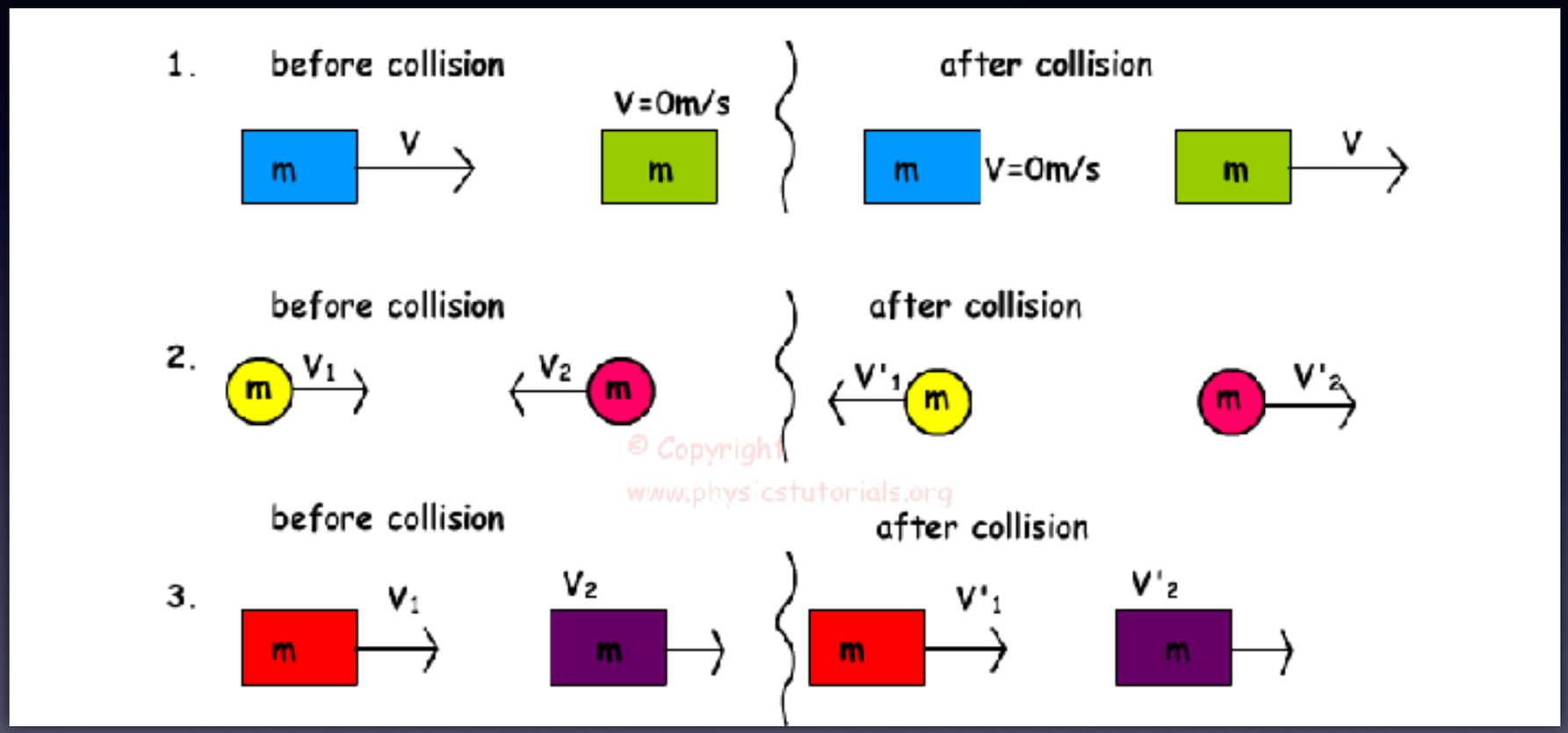
Collision with Connected Objects



If a moving train collides and locks with a train at rest, both cars will then move, but they will move more slowly than the first car did.

In each of these examples, momentum is conserved.

Collision with One Moving Object



If a moving train collides with a train at rest, the first train stops moving and the second train begins to move.

All of the momentum has been transferred to the car that was at rest.

Keywords: English - Spanish

Newton's Third Law of Motion
La tercera ley de movimiento de Newton

Momentum - Impulso

Conservation - Conservación

Conservation of Momentum - Conservación de Momento